Application of evapotranspiration and soil moisture remote sensing products to enhance hydrological modeling for decision support in the New York City water supply

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Partners / Problem

- NYC manages a 60-120 year old system of reservoirs, aqueducts, tunnels supplying 9 million people
  - Water quantity: Drought now rarely poses serious problems, but earlier snowmelt, hotter summers are threats
  - Water quality: function of rain rate, soil moisture as well as land use
- Lessons to be shared with water managers regionally via Consortium for Climate Risk in the Urban Northeast (CCRUN)

Science objective

- Improve understanding of water budget during low-flow periods
  - *Equifinality* is a challenge – models may perform well under current conditions but do poorly for processes that aren't calibrated – or for future conditions
  - ET is the largest summer water flux, yet no ET or soil moisture data currently used to calibrate NYC watershed models

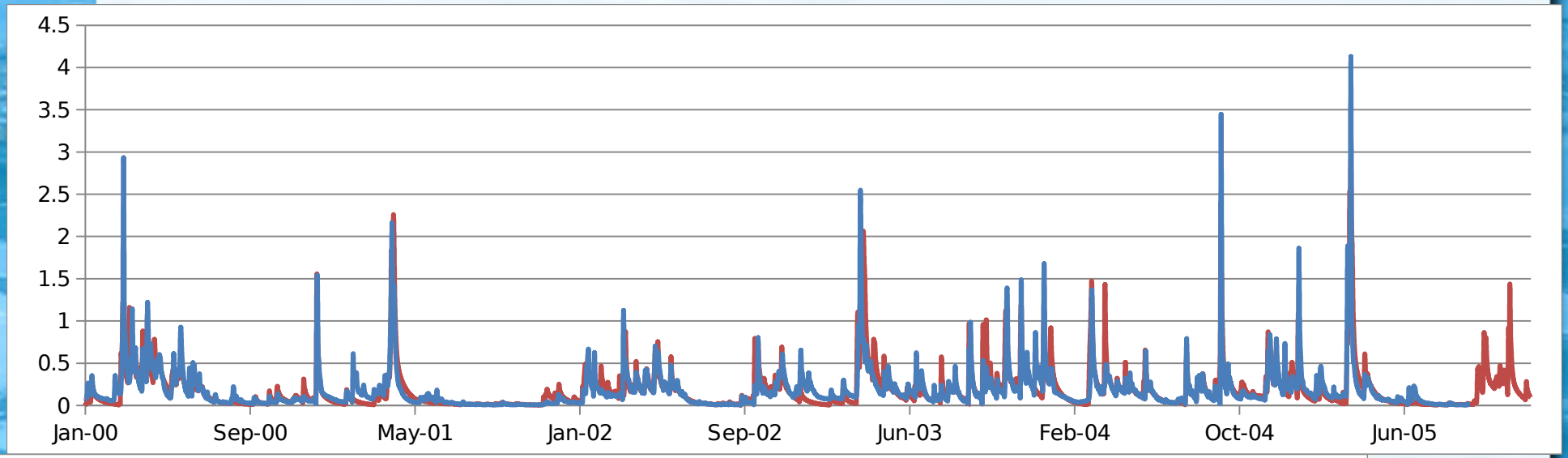
Policy objective

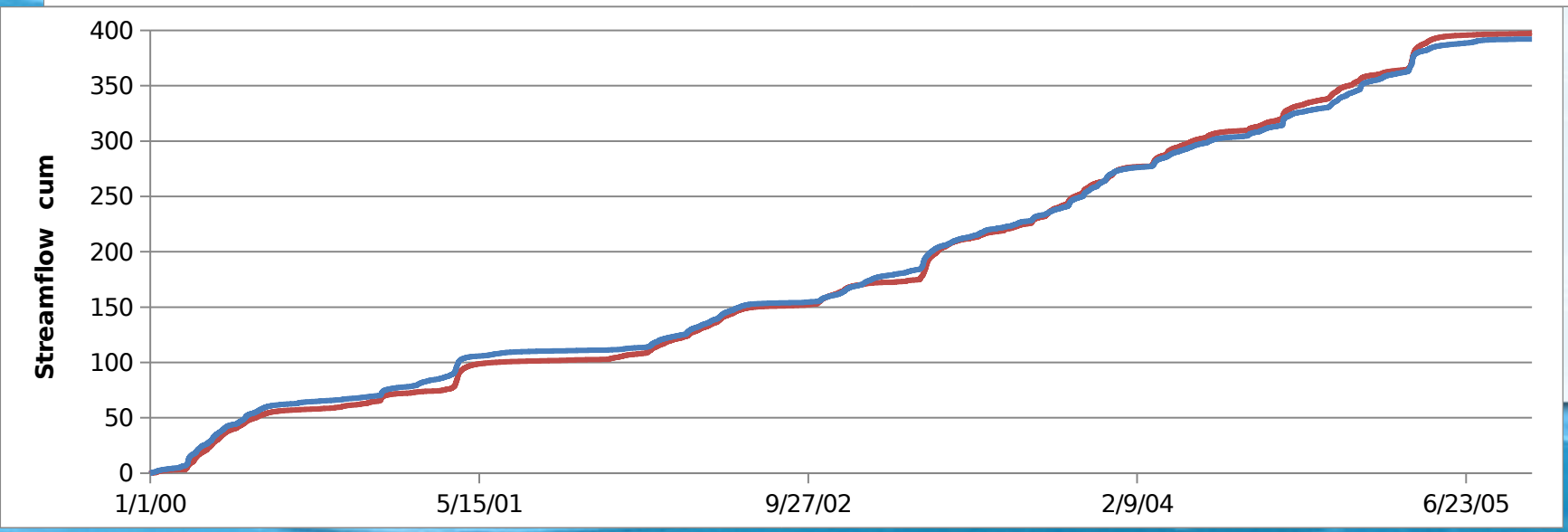
- Enable water managers to make use of remote sensing information
  - Systematically compare remote sensing data and operational watershed models
  - Deepen working relationships and interaction between municipal agency and academic, NASA, NOAA scientists

Technical approach

- Use multiple remote sensing and other products to estimate summer water stores and fluxes and highlight areas of uncertainty
- Examples:
  - Soil moisture and freeze/thaw: AMSR-E; SMOS; (SMAP)
  - ET / drought: MODIS Global ET Project; GOES thermal product
  - Vegetation health: VHI; EVI
  - Precipitation: PRISM; ST-IV
  - Water storage: GRACE

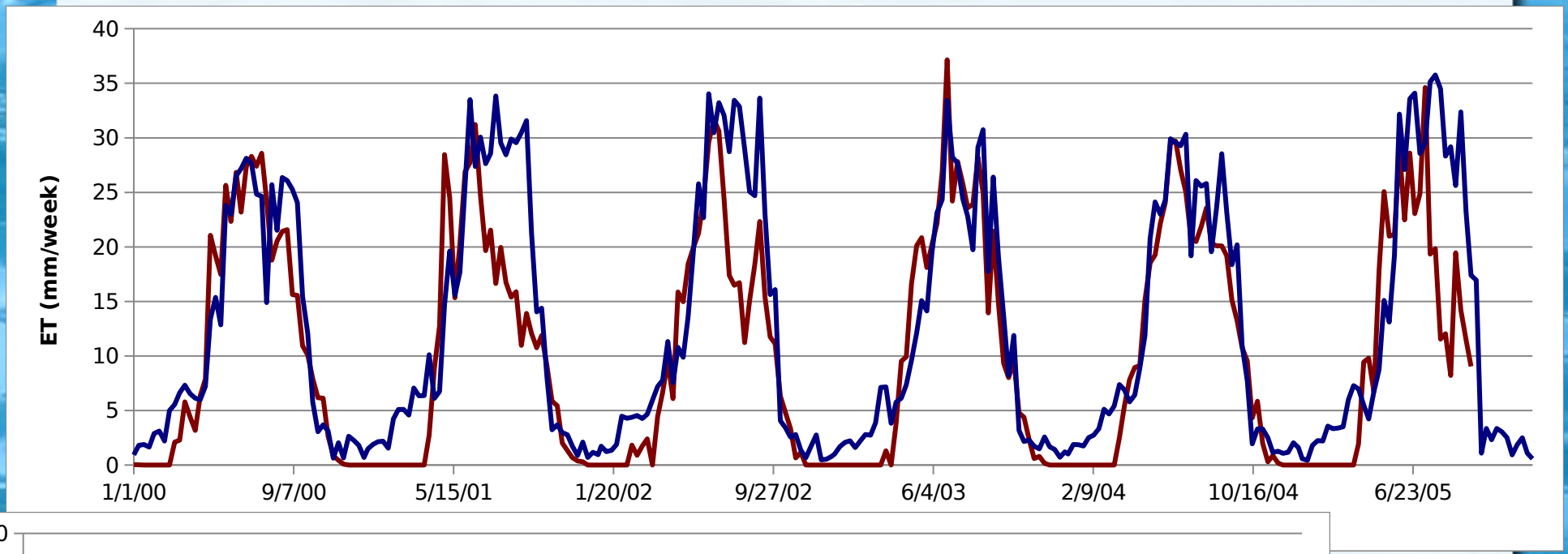
Initial results: Calibrated model gets streamflow right...

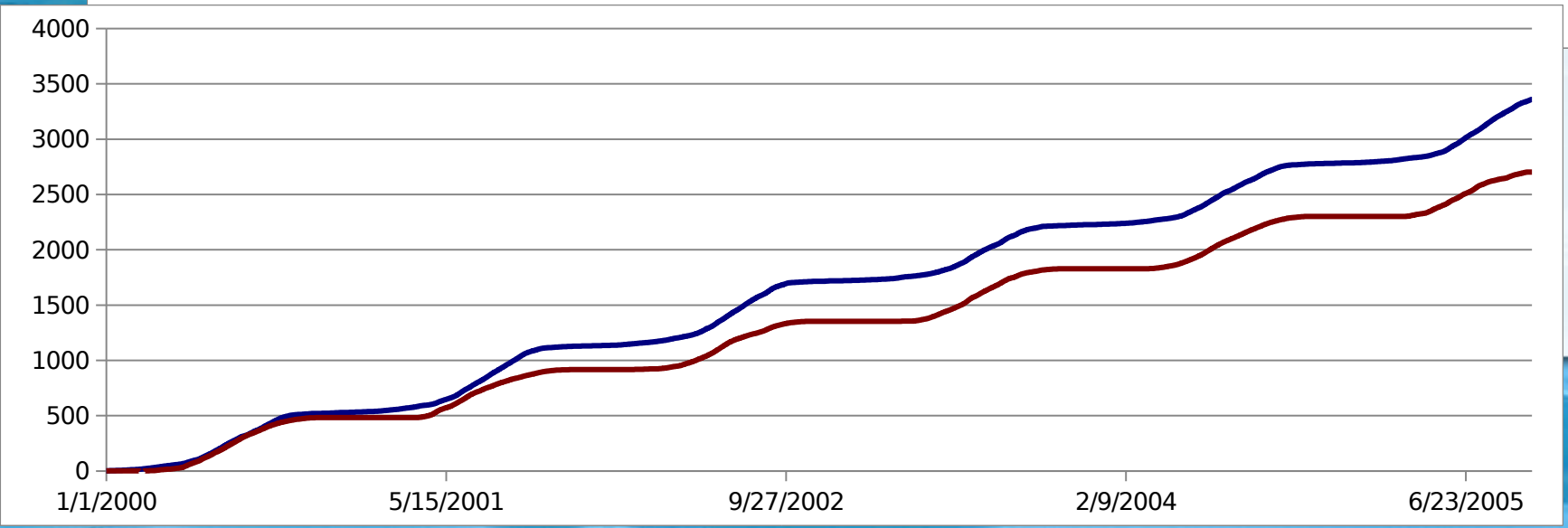




West Branch Delaware River (860 km^2); Blue: Gauge, Red: GWLF model

But are individual water balance terms consistent?





Blue: MOD16, Red: GWLF model

Goals and Metrics – Science

- Use remote sensing products to provide information relevant to watershed-scale hydrological modeling of drought conditions.
  - *Identify suitable remote sensing products and estimate uncertainties.*
- Use remote sensing products to calibrate/verify parameters in watershed hydrological models under drought conditions.
  - *Improved watershed model representation of water quantity and quality under low flows in out-of-sample verification tests.*

Goals and Metrics – Policy

- Better NYC water management from improvement in hydrological modeling capability for drought.
  - *Delineate pathways leading from improvement in model performance to gains in drought preparedness.*
- Water resource application work communicated and extended across the remote sensing and water resources fields.
  - *Describe work in conferences and journal articles; attract interest in new collaborations and extensions.*